Sustainability: Building Green Facilities and Supply Chains

Strengths, Weaknesses and the Business Case

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This paper discusses building green facilities as it pertains to the issue of sustainability. It begins with defining sustainability and providing a short overview of three important perspectives for implementation. The paper then defines the notion of a green facility as well as a case example of a green home from 1979, built before the coining of the term "green". An analysis is then provided for the emerging case for building green. The importance of supply chains in green work spaces is further discussed using case examples of sustainable supply chain practices. The risks and challenges of green building are weighed through "SWOT" analysis (strengths, weaknesses, opportunities and threats) associated with building green facilities. The SWOT analysis is then followed by alternatives to new LEED-certified (the U.S. Green Building Council's **L**eadership in **E**nergy and **E**nvironmental **D**esign construction), and a discussion of risks and challenges of green building.

Green Facilities and Sustainability

The concept of green facilities has a direct relationship to the very important concept of sustainability. Collier & Evans (2011) defined sustainability in OM^3 as follows:

> Sustainability refers to an organization's ability to strategically address current business needs and successfully develop a long-term strategy that embraces opportunities and manages risks for all products, systems, supply chains, and processes to preserve resources for future generations (p.17).

Collier and Evans go on to discuss three perspectives from which sustainability can be viewed:

> Environmental sustainability refers to "an organizations commitment to the long-term quality of the environment" (Collier & Evans, 2011, p.17), as natural resources are being diminished. Social sustainability refers to "an organization's commitment to maintain healthy communities and a society that improved the quality of life" (Collier & Evans, 2011, p.17). Thus products should enhance this quality. Economic sustainability refers to "an organization's commitment to address current business needs and economic vitality, and to have the agility and strategic management to prepare successfully for future business, markets and operating environments" (Collier & Evans, 2011, p.18).

We can see from the above that all three of these perspectives enhance one another and are therefore an integrative system for successful implementation of sustainability. Three important contexts have been included for the successful practice of sustainability: the environment, quality of life in the community, and the organization's own business sustainability. A principle participant in the new green construction standards is the LEED-certification program, which is described by Ryan (2008) as follows:

> The LEED program has four distinct certification levels based on a 69-point rating system. The system evaluates sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and LEED innovation credits. The certification levels for LEED construction include LEED Certified (26-32 points), LEED Certified Silver (33-38 points), LEED Certified Gold (39-51 points), and LEED Certified Platinum (52-69 points).

What Is a Green Facility?

Many people are not aware of the level of energy consumption surrounding buildings. According to the Environmental Protection Agency (2013) buildings in the USA account for the following:

- 39 percent of total energy use
- 12 percent of the total water consumption
- 68 percent of total electricity consumption
- 38 percent of the carbon dioxide emissions.

A facility is a space in which people work and/or live. The main focus of this analysis will be work spaces and work practices. According to the Environment Protection Agency, the following elements make a building green:

- It is efficient in its use of energy
- It makes an effort to use renewable energy sources
- It is efficient in its use of water
- It uses sustainable building materials, which includes recycled materials
- It keeps waste to a minimum
- It keeps the use of toxic materials to a minimum
- It maintains excellent indoor air quality (which is also good for the humans who work inside of the building).

The Pennsylvania Governor's Council on Green Building (n.d.) mentions the commonly understood range of definitions of green building. They span a continuum from 'not as bad' in impact on the environment, to 'notably better' than the average building. Other definitions go much further: "…to represent a regenerative process where there is actually an improvement and restoration of the site and its surrounding environment." (n.d.)

In addition, the Pennsylvania Governor's Green Government Council offers a clear general definition of green building:

> A green building is one whose construction and lifetime of operation assure the healthiest possible environment while representing the most efficient and least disruptive use of land, water, energy and resources. The optimum design solution is one that effectively emulates all of the natural systems and conditions of the pre-developed site – after development is complete (n.d.).

Both the EPA and Pennsylvania Governor's definitions of green building show that is applicable to the subject of sustainability as it applies to the first perspective discussed above, which is the care and protection of the environment.

The European Regional Network of the World Green Building Council extends the notion of green building to span a variety of structures and notes the following:

- The design of homes is crucial to quality of life
- The design of schools leaves a life-long imprint to those who learn within them
- The design of workplaces impacts employee productivity and as well as health and prosperity of the companies

- The design of hospitals impacts patient recovery and health services bills
- The design of cities and communities impacts their economic and social dynamics

These elements are applicable to Collier and Evans' second perspective regarding sustainability, which is the improvement of quality of life.

The European Regional Network of the World Green Building Council (n.d.) makes its case on the importance of green building. The ERA states that green building:

- Takes an intelligent approach to energy
- Safeguards water resources
- Minimizes waste and maximizes reuse
- Promotes health and well being
- Keeps landscapes green
- Creates resilient and flexible structures
- Connects the community interpersonally as well as ensures that transportation serves key points in a population.
- Considers all stages of a building's life cycle
- A case example is provided in the next section for further illustration of this idea.

Case Example of an Early "Green" Home: 1979

In 1977, one of the co-authors of this paper (Earon Kavanagh) was completing a four-year apprenticeship in carpentry and building construction, and had read a book called *The solar home book: Heating, Cooling and Designing with the Sun* (Anderson, 1976) written about the then pioneering version of sustainable homes. The book offered designs and practices for building an energy-efficient home by using passive solar heating, and solar heating through installed technology systems. Kavanagh worked with a home designer and designed a plan for a passive solar home, which used large airtight windows, thicker walls with higher insulation value, a southern exposure for maximum sun heat, and properly sealed wall areas to keep out drafts. Kavanagh started building this 1054 square foot home in 1979 and set up the project on a tight budget. The construction proceeded according to plan; however, due to the tight budget and rising costs of materials, some corners needed to be cut. Kavanagh was then forced to purchase cheaper windows for the southern wall. This resulted in mild drafts and some winter ice buildup, located on a large kitchen window and a patio door. Nevertheless, the home did maintain heat reasonably well, and these two windows could have been easily upgraded at a later date.

Based on the range of definitions provided by the Pennsylvania Governor's Council on Green Building, it can be ascertained that a passive solar, energy-efficient, home built in 1979 was notably better than the average home, based on its passive use of sunshine as an additional heating resource, and the environmentally aware practices of the home owners.

Reflection on the Above Green Home Project

At the time the above house was built (1979), there was less focus on environmental sustainability, and such living spaces were considered to be within the innovative practices of a relatively small group of aficionados. However, in the above project, the two perspectives of community, quality of life, and environmental sustainability were addressed reasonably well. Unfortunately, Kavanagh did not allow enough funds to see the project through as it was designed, which was to be fully sustainable (energy-efficient) upon completion, without any additional work needing to be done. This was acceptable as the project was envisioned as an experiment and designed for Kavanagh's personal use.

Other concepts that were incorporated into Kavanagh's green living home were composting of certain household waste materials, and growing one's own vegetables in small gardens. Eating organically was a complimentary pathway to maintaining a healthy lifestyle, as well as boycotting big-business farming systems that used pesticides. By living in energy-efficient homes and engaging in a healthy and sustainable lifestyle people would take extra care in the management their own daily supply chain. While the above was a residence, design concepts such as energy-efficiency and sustainable supply chain management are still relevant, though the bar has been raised.

The Business Case for Building Green

So the question still remains, why build green? Is the reason simply because it makes us all feel good inside? Yes, sustainability is about responsibility, but are there further reasons that companies are making an effort to build green? It is clearly being done. According to SmartMarkets: World Green Building Trends, (McGraw-Hill, 2013: p. 5) a 2008 study shows that 51% of architects polled believe that by 2015, over 60% of their work will be green and that only 2% of buildings will not have any green components (McGraw-Hill, 2013: p. 5).

Research from the above paper also suggests that green work is no longer being done because it is "the right thing to do" but out of necessity because customers and associates in the marketplace insist upon it. Customers might not want to associate themselves with companies that are not responsible when it comes to sustainability, and that makes building green a necessary business decision in addition to being good for the planet and those living on it (McGraw-Hill, 2013: p. 6).

Lastly, research has shown that building green actually offers financial benefits. The following is a summary of the business benefits expected from green building investments (median value) for both new and retrofitted buildings (McGraw-Hill, 2013: p. 7):

- Payback Time for Green Investments (New- 8 years, Retrofit- 7 years)
- Increased Asset Value for Green versus Non-Green Projects (According to Owners) (New- 5%, Retrofit- 4%)
- Increased Building Value for Green versus Non-Green Projects (According to AEC Firms: New- 7%, Retrofit- 5%)
- Decreased Operating Costs Over Five Years (New- 15%, Retrofit- 13%)
- Decreased Operating Costs Over One Year (New- 8%, Retrofit- 9%)

Supply Chains in Green Workspaces

It was briefly discussed above how Kavanagh's energy-efficient home included family supply chain practices: using the sun to passively assist in heating the home, growing organic vegetables, as well as recycling of waste and composting to enhance garden production. Collier and Evans (2011: p. 177) note that supply chain design is an important component of sustainability. Thus, in work spaces, while a green design supports sustainability, it is important to engage in sustainable supple chain practices. This further enhances Collier & Evans' perspective on sustainability and its positive impact on the environment. The authors define a green supply chain as "the process of using environmentally friendly inputs and transforming these inputs through change agents – whose by-products can improve or be recycled within the existing environment" (Collier & Evans, 2013, p. 188).

The outputs of a sustainable supply chain can thus be reclaimed and re-used at the end of their life-cycle, and this creates a sustainable supply-chain. A more simple understanding of

this can be gleaned from the energy-efficient home. The recycled vegetables and coffee grains are converted to compost and used in the garden soil, which then produces vegetables of higher quality without the need to use chemical fertilizers. Such family supply chain practices have been carried out in both farming and fishing communities for centuries, with the use of manure and fish heads to enrich and enhance soil production. One major industry challenge regarding sustainable supply chains is their innovation (Odom & Nelson, n.d.). Green building is a very new concept and, when it comes to construction, nothing is tried and true until it is just that, tried. It is not known how green building and their novel materials will perform over time until they have been used and time has had its opportunity to do its damage. This will continue to be a challenge as new sustainable building materials are developed and introduced into the green building supply chains. Over time, the reliable and effective materials will take precedence and the failures will be flushed out.

Case Examples of Green Supply Chain Practices

Collier and Evans (2011: p. 178) write that 3M began to stack pallets on two levels for shipping on their trucks. The result was a reduction of daily truckloads by 40%, and a saving of $110,000 per year.

Other examples include the following:

- Offices printing on both sides of each sheet of paper
- Adopting paperless practices for billing and purchasing
- Selecting suppliers that support sustainability for example, painting suppliers which do not use toxic materials in their products (Ryan, 2008)
- Converting wastes to by-products
- The use of skylights, windows, and efficient glass as a source of ambient light and to reduce the need for excessive heating or cooling (Ryan, 2008)
- Employing water saving fixtures such as waterless urinals and toilets which allow the selection of a low water consuming flush (Ryan, 2008)
- Recycled carpet (Ryan, 2008)

SWOT Analysis on Green Building and Assumptions

Although the decision to pursue green building is increasingly popular, it is not a foregone conclusion. As of 2008, only 48% of construction in the U.S. market was

green (McGraw-Hill, 2013: p. 11). However, that percentage is growing. Between 2009 and 2012 the number of firms reporting a "high level" of green increased 2.5 times, and is expected to increase an additional 33% by 2015 (McGraw-Hill, 2013: p. 11).

A SWOT Analysis examines strengths, weaknesses, opportunities and threats associated with a venture of topic. In order to develop the SWOT analysis, we developed a list of assumptions. These assumptions were based on the corporate capacity and facilities, gaps in knowledge, and factors related directly to construction and certification of green facilities. The SWOT Analysis assumptions are listed below.

Assumption 1: corporate capacity and facilities

The corporation has either sufficient available funds to bear the additional cost of green materials/design, or can leverage them. The current facility is owned rather than leased/rented or the cost of purchase for the site does not reduce return on investment (ROI) below that of current lease/rental.

Assumption 2: gaps in knowledge

Health and productivity benefits can be difficult to define; which may make a cost benefit analysis difficult. Acknowledged gaps in current research in regards to savings will exceed those which are currently available based on "conservative estimates" (Kats et al, 2003). Non-financial benefits (i.e. the health savings and costs associated with those savings) are difficult to assess in advance.

Assumption 3: construction and certification

The corporation will not only choose a green design, they will additionally pursue LEED certification. Additionally, all selected materials will meet building codes. Energy credits (i.e. tax benefits) for going "green" will continue. In the event that LEED certification is missed due to consequential damages, a bond or other form of collateral will be used to offset the difference in savings.

SWOT Diagram and Analysis

	Helpful to achieving the objective	**Harmful** to achieving the objective
Internal origin (attributes of the system)	*Strengths* • Shows dedication to social responsibility and sustainability • Frees up cash flow • Responsive to established demand • Improved work environment, and enhanced employee productivity	*Weaknesses* • Lack qualified project managers • Overall Staff awareness of requirements and techniques is low • Resistance due to perceived cost • Potential Required Collateral • Adequate and appropriate insurance
External origin (attributes of the environment)	*Opportunities* • Potential financial benefits • Potential non-financial benefits • Protect Natural Resources • Lower green house gas emissions • Prepared for changing market	*Threats* • Regional differences not addressed in LEED • Challenges throughout project life • Multiple rating systems • Untested/new materials

Strengths

Although green construction is increasingly viewed purely as a business opportunity, as opposed to a practice in social responsibility at the corporate level (McGraw-Hill, 2013, p.16), companies that make efforts in green construction are perceived as having greater dedication to sustainability, social justice, and environmental concerns. Additionally, they are more responding to the markets increasing expectation of green facilities. This perception can be further expanded, with the improved work

environment and resulting increased employee productivity. Implementing green designs also frees up cash- as result of savings in energy and water consumption.

Weaknesses

Most corporations do not have LEED certified project managers. Additionally, overall staff awareness of requirements, materials, and techniques is low. These knowledge gaps can contribute to oversights in regards to underbidding, design flaws, and construction issues (Andre, 2012), (Henderson & Usdan, n. d.). Although these problems can be mitigated through a more rigorous Request for Proposal and contracting process, it is an added burden.

A further weakness is the possibility that there will be significant resistance due to the higher initial costs associated with green construction. This could potentially be compounded by a requirement for collateral to be held for five years, until the actual energy and environmental performance is consistent with the level of LEED certification or imposed green building requirements (Andre, 2012). Additional costs may also be incurred in securing "green" insurance, which would allow for damaged facilities to be repaired or reconstructed at the original LEED certification level.

Opportunities

Green construction opens the door to both financial and non-financial benefits. These may include federal and state tax incentives, zoning benefits, and expedited building permits (Andre, 2012). Additionally, the lower consumption of energy and water help to protect natural resources and lower green house gas emissions. As previously discussed, green construction is increasingly seen as a business decision. However, green buildings are continuing to rise in demand: the top three triggers for green construction in the U.S. are client demand, corporate commitments, and market demand for lower operating costs (McGraw-Hill, 2013, p. 16). A successfully completed green building will have higher resale value and be more attractive to renters/lessees.

Threats

Most of the green construction in the U.S. (91%) is completed by firms that utilize LEED standards (McGraw-Hill, 2013). This is of note, because regional differences in climate are not addressed in LEED standards; this means that in "challenging" environments (rainy, mixed, hot/humid, or very cold regions) green design elements may lead to other problems. LEED certification also requires that only one rating system be used- however, there are multiple rating systems to choose from (Andre, 2012). Green construction does pose additional problems: during design, construction, and even close out (Henderson & Usdan, n. d.). This can be attributed to issues with relatively untried materials, delays or substitution of sustainable materials, design failures, and litigation due to not meeting the agreed terms.

Alternatives to New LEED-certified Construction

In the event that a new LEED certified facility is determined to be outside the best interests of the corporation there are alternatives. The first alternative is the refurbishment of current facility. This would be less expensive than new construction, would improves work environment, and still provide some of the long term cost savings from new green construction. However, this alternative can lead to shortened facility life time due to modifications. Also, it does not maximize long-term savings. And, although the overall cost for retrofitting may be lower, dollar-to-dollar with new construction, it is less valuable. The second alternative is to construct a new facility utilizing some but not all green design and construction. Though not certified, benefits would include reduced initial costs, provides some positive impacts (usage, health, etc.), and is easier to fund in poor economic environment. The consequences associated with this alternative are loss of long-term savings due to incomplete implementation, and it does not maximize health/well-being components for employees.

Discussion of Risks and Challenges

Green building may be very attractive to owners and builders, but no new venture or idea will be without risks obligations. Green building is no different. For example, who is to say

that a building is green? How green does it really need to be for an owner to make the claim? As with most things, some oversight was needed, and that is why the U.S. Green Building Council (USGBC) and several other certifying agencies were created, though the USGBC and its LEED certification is the most prominent.

A green building will need to address all of issues that any other building would need to address, but has the burden of additional issues as well. Below is a summary of some of those issues:

- Which agency will certify the building, to what level and who will oversee that responsibility
- Management of any tax benefits
- Making preparations for the possibility that certification will not be achieved and any financial implications that may bring.

Conclusions

Although the reasons driving the decision to pursue green construction have changed over time, the main barriers remain very similar: increased initial costs, establishing a balance between capital expenditures and operational cost savings, potential pitfalls due to design flaws or improper use of materials, and actual expected savings.

The LEED system provides a standard that allows qualification of actual construction practices, and when properly utilized can be used to estimate potential savings associated with designs. Although the design, bid, and construction processes may be more involved than a standard construction project – it is necessary to maximize the benefits of pursuing green construction.

The demand for green facilities is increasing. This is due to market transformation. Lower operating costs, branding, public relations, and social responsibility have combined to increase client demand. Sustainability is always a corporate concern, and implementation of green construction aids in meeting corporate goals. This move also pushes resale value of green facilities above that of traditionally constructed facilities. Although associated risks may be greater than with traditional construction, they are outweighed by the tangible and intangible benefits generated by green facilities.

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